

Docket No. 99/122

IN THE UNITED STATES PATENT AND  
TRADEMARK OFFICERECEIVED  
CENTRAL FAX CENTER

JAN 08 2007

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PROVISIONAL PATENT APPLICATION

TITLE: LOCATING SYSTEM AND METHOD

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**FIELD OF THE INVENTION**

The invention relates to tracking systems that use GPS information and cellular telephone.

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**BACKGROUND OF THE INVENTION**

There are systems that involve a tracking function performed by a centralized and stationary unit. Examples of such systems are shown in U.S. Patent Nos. 5,594,425; 5,312,618; and 5,043,736. In the usual case, a target's location information is transmitted to a monitoring station where the information is processed and actions taken accordingly.

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A variation to this is shown in U.S. Patent 5,389,934 which allows the searcher/controller to be mobile; where in one embodiment the system described is a rover which when called by a telephone would become active, relay a voice description of its location and then become inactive; and another embodiment provides an arrow visual to point in the direction of the target, but does not take advantage of the specific spatial relative

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calculations used in the present invention

**SUMMARY OF THE INVENTION**

The invention resides in a system for locating and tracking at least one rover unit from a mobile controller unit, where the mobile controller unit has a radio communication device and a GPS module and the rover has a radio communication device and a GPS module, the controller being programmed to receive GPS position information from the rover unit by way of the radio communication device and using its own GPS module, calculate the relative position and bearing of the rover unit, and using a display on the controller unit showing a relative bearing distance and altitude difference, or alternatively,

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map positions of the controller and the rover using available map data. The radio communication module is preferably a cellular telephone.

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The controller unit allows the user to select from displayed options, a selected rover from a stored directory of rovers to activate a "FIND" process to obtain the selected rover's GPS position relative to the controller's GPS position. Also, the rover unit has a stored history of positions of the rover unit(s) so that a historical trail of the rover's positions can be sent to the controller and displayed. Also, selective alarms may be programmed from the controller, into the rover so that when the rover violates the alarm limit, the rover automatically signals the controller and the display shows the rover's selective or absolute position, along with a signal as to the basis for the alarm. Alarms may be spatial such as a boundary or radius passed or may activate at a velocity limit, if the rover starts to move faster than the alarm limit. Also, the rover may be equipped with a manually activated alarm to signal the controller.

Thus the invention has as one use for keeping in touch with children, periodically determining a child's location or trail of movement, or alarm limit violation.

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**BRIEF DESCRIPTION OF DRAWINGS**

Fig. 1 shows a controller unit operational diagram.

Fig. 2 shows the a rover unit operational diagram.

Fig. 3 is a flow chart of the controller start procedure.

Fig. 4 is a flow chart of the phone start procedure.

Fig. 5 is a flow chart of the phone memory procedure.

Fig. 6 is a flow chart of the find memory procedure.

Fig. 7 is a flow chart of the find procedure.

Fig. 8 is a flow chart of the find detail procedure.

Fig. 9 is a flow chart of the process GPS messages procedure.

Fig. 10 is a flow chart of the process remote messages procedure.

Fig. 11 is a flow chart of the process user input procedure.

Fig. 12 is a diagram of an interactive home screen.

Fig. 13 is a diagram of an interactive phone screen.

Fig. 14 is a diagram of an interactive manual phone screen.

Fig. 15 is a diagram of an interactive find screen.

Fig. 16 is a diagram of an interactive find detail screen.

Fig. 17 is a diagram of an interactive map screen.

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**DETAILED DESCRIPTION**

5 The method and apparatus of the present invention is intended, as a primary application, to enable a person to find another person, upon command and to high precision. An exemplary purpose is such as to enable a parent to find a child.

The system is comprised of a personal hand held unit (controller), and a small, compact, and cancelable unit (rover). Each controller unit gives the user the ability to ascertain the precise location of one or more rover units. In addition to all the functions and features of the system as described herein, the system is unique in that each controller unit is a self contained, mobile unit that can provide to the user all the real-time information necessary to locate and find any rover.

10 The controller unit comprises several primary sub-components including a radio communication module such as a cellular telephone module, a GPS receiver/processor module, an electronic compass, a display, a computer and associated electronics to operate it. The controller provides three distinct and interactive and useful functions. First, the controller unit is a fully functional cellular telephone with all the typical functions and features. Second, the controller unit can display it's own position and the position of a rover unit on a street map. Third, the controller unit provides the relative location of any rover using the controller unit as the center and displaying a bearing arrow.

20 To operate the system as a locator for a rover, the user selects the FIND feature on the controller screen. The screen displays all the pre-programmed rover names and cellular telephone numbers. The user selects a specific desired rover and touches GO on the interactive screen. The controller unit opens communication with the rover unit by cellular telephone. Using each unit's GPS module, the controller unit determines it's spatial relative relationship with the rover. In one display mode, the controller unit displays the rover unit's location on a street level map which is capable of zooming and scrolling. Through continuing data from the rover unit, the rover unit's position is tracked on the map as GPS information is sent from the rover unit to the controller unit. In another display, the compass bearing location of the rover unit relative to the controller is displayed as an arrow accompanied by information. The arrow displays the bearing of the rover relative to the controller taking into account the location of the rover unit, the location of the controller unit, and the heading of the controller unit based on it's GPS and digital compass data. The information displayed along with the arrow preferably includes controller unit to rover unit distance, rover unit velocity, rover unit height relative to the controller unit, the time at

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which the rover unit's data was ascertained and the rover unit's latitude, longitude and elevation. The arrow display is used primarily when the controller unit and the rover unit are relatively close, such as in a neighborhood, where a directional arrow is useful for the controller unit user. To implement these displays, the controller unit receives GPS data which provides the relative spatial relationship to the controller unit and the rover unit to high precision, as good as 1 meter accuracy. In order to achieve this precise relative spatial relationship, the rover unit and the controller unit gather and share GPS measurements of pseudo range and carrier phase from the same GPS satellites. Much of the error in GPS positioning occurs due to errors that are common to the two receivers making measurements close in time and space. Therefore, having knowledge of the two receiver's GPS measurements allows for removal of the common errors and consequently, a precise calculation of the relative spatial orientation of the two units as well as good knowledge of the units' absolute position. Optionally, the bearing and distance information can be presented in an audible fashion.

In another embodiment, the controller unit can be sent historical GPS information for the rover unit, which can be displayed as a series of points on the display map or using the controller unit position as a series of points relative to the controller unit to show a trail of travel of the rover over time both historically and contemporaneously, while being displayed.

Another feature is that the controller unit can activate an audible alarm or chime on the rover unit to facilitate finding the rover audibly.

In another feature, preselected limits or boundary conditions set for the rover unit which when the limit or boundary condition is violated or exceeded can self-activate a communication to the controller unit and an alarm signal and automatically display the relative spatial relationship or map relationship between the controller unit and the rover unit. As a cellular telephone, the controller unit can establish voice communication with the rover unit.

Should the controller unit not have the necessary map data for the current positions of the controller unit and the rover unit, it can access a central database via a cellular radio link and download the necessary map data and then resume tracking of the rover unit. Also a normally activable alarm button can activate the system to find the rover on the controller unit.

In the exemplary application, a parent is in possession of a controller unit while a rover unit is in the possession of a child. As described below, the person operating the controller unit can find the rover unit and sees on the display the relative spatial location or

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the absolute map location of the rover unit. Other capabilities are also available, as described below.

It is contemplated in the exemplary application that a parent or equivalent will be in possession of a controller unit, and rover units will be in the possession of one or more children. The rover units can be very small, and are preferably concealed, as it is a purpose of the invention to allow locating of the child even in the event of foul play, although much of it's use contemplates merely checking up on the child, or finding a lost child.

To be operable at least one controller unit and at least one rover unit is needed. There may be a plurality of controller units, such as for two or more persons who are desired to be tracked by rover units. There will be as many rover units as needed for the persons to be tracked, such as one or more children. A set-up procedure is implemented in which the cellular numbers of each rover unit are programmed into the controller unit, along with an identity code, for automatic dialing. Also, each rover unit is programmed for dialing the controller unit, or if there are more than one controller units, for dialing them selectively or automatically in a selected order or simultaneously. Notably, the basic system does not allow for or need any steps to be taken at the rover unit to operate the system (except in the case of the "alarm" procedure which will be explained). Therefore, the cellular transceiver of the rover unit is activated by commands from the cellular transceiver of the controller unit.

Figures 1 and 2 show general block diagrams for the controller and the rover unit modules and their interrelationship. The controller unit 10 has a GPS receiver module 12, a cellular transceiver module 14 a display module 16 and control electronics module including a specially programmed CPU 18 and a digital compass 20. The display 16 is preferably an interactive display such that various command options can be displayed and activated by touching the display screen. Software modules include the Operation Mode Module 22, the Graphical Mode Module 24, and the Message To Rover Module 26. Outputs of the CPU 18 include the Position Module 28 which operates the Search Screen Module 30 and the Mapping Module 32 which operates the Map Screen Module 34.

The rover unit 36 has a GPS receiver 38, a cellular transceiver 40, and a control electronics module including a specially programmed CPU 42. Use of the apparatus and method is best understood with reference to the flow diagrams of Figs. 3-11 as well as the screen diagrams of Figs. 12-15.

Referring to Fig. 3, the controller unit is activated by a power-on step indicated as start 50. This causes the display 52 to open. As shown on Fig. 12, this display, called the home screen 54 has buttons for PHONE 56, FIND 58, EXIT 60, AND HOME 62 (which

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should be muted on the home screen 12). The user selects one of these as at step 64 on Fig. 3. PHONE selection allows use as at 68 as a conventional voice cell phone between the controller unit and a selected rover unit or as a general use cellular phone. EXIT selection turns off the controller unit as at 70. FIND selection begins the find procedure as at 72.

5 Fig. 4 shows the procedure if the PHONE button 56 (Fig. 12) was touched. This opens the PHONE screen 74, Fig. 13, which has a scrollable list of preprogrammed numbers 76, an Up/DOWN scrolling button 78, a memory button 80, for adding or deleting numbers, a MANUAL button 82 for going to the screen of Fig. 14 for normal telephone use, and a home button 84 to return to the home screen, Fig. 12. If the manual button 82 is  
10 touched, the screen 90 of Fig. 14 appears. It has a touch pad 92, a RECALL button 94, a CLEAR button 96, a SEND button 98, END button 100 and HOME button 92. The screens of Figs 13 and 14 are for programming numbers (Fig.13) and using the controller unit as a voice cellular telephone (Fig. 14). The use of the buttons on Fig. 14 are conventional to cellular telephones.

15 At Figs. 3 and 12, if the user selects FIND, the find procedure of the invention is begun. A find screen 110 as shown at Fig. 15, appears on the display. This screen has a scrollable NAME window 112, which may be scrolled vertically to select a rover or horizontally as shown at 114 to display preprogrammed alarm criteria for each rover such as ZONE STATUS and ZONE RADIUS.

20 The GO button 116 activates the FIND DETAIL screen of Fig. 16. The ACTIVATE ZONE button 118 allows programming and activating a zone radius. The zone radius will be displayed at ZONE RADIUS and communicated and stored in the rover unit which is programmed to automatically call the controller unit and sound and/or display an alarm if the zone radius is passed. ZONE STATUS shows whether the rover is inside or  
25 outside the displayed ZONE RADIUS. The MEMORY button 120 stores a zone radius selection. The HOME button 122, returns the display to the HOME screen, Fig. 12. Touching the MEMORY button 120 brings up a screen (not shown) to enable programming the functions of the FIND screen 110. This procedure is shown in the flow diagram of Fig. 6, FIND MEMORY.

30 With the FIND screen 110, displayed, the procedure shown in Fig. 7 is implemented. The scrollable NAME window 112 has a list of names and phone numbers that have been pre-programmed. The user now selects HOME, MEMORY, or GO, 124. If the MEMORY button 120 is touched, the FIND MEMORY procedure begins (Fig. 6) which allows programming or deleting on the NAME window 112.

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If the GO button 116 has been touched, the FIND DETAIL procedure of Fig. 8 is begun and the FIND DETAIL screen 130, Fig. 16, is displayed. As shown in Fig. 8, the FIND DETAIL procedure starts at 132 from the prior touching of the GO button 116 of the FIND screen of Fig. 15 to set up the FIND DETAIL screen of Fig. 16.

5 The FIND DETAIL screen 130 has an identification window 132, a location and data window 134, a geographical coordinates window 136, a status window 138, and buttons, HOME, 140, CENTER, 142, BREAD CRUMB, 144, STORE, 146, STOP 148 and MAP, 150.

10 Within the geographical coordinates screen 136, a reserve 152 shows a bearing arrow 154 which operates via the CENTER button 142 for spatial relative positioning of the rover to the controller, in which the arrow shows the bearing of the rover unit relative to the controller unit. This is accomplished using the electronic compass module (Fig. 1).

15 Touching the HOME button 140, returns to screen Fig. 12. Touching the CENTER button 142 activates display of the spatial relative position bearing arrow 154, using the electronic compass and the GPS positions of the controller and the rover.

20 The BREAD CRUMB button 144 is used with the MAP button 150 which will activate the MAP screen Fig. 17 and will show the positions of the controller and the rover on a map, and with the BREAD CRUMB feature activated, will show a number of prior GPS positions of the rover and will continue to display sequential periodic positions of the rover.